

# **California's Plan for Surveying Marine Recreational Fisheries**

**January 1 to December 31, 2004**

Marine Region

California Department of Fish and Game

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## **Executive Summary**

In recent years, many recreational management decisions for state nearshore species and federal groundfish species have been based on the Marine Recreational Fisheries Statistics Survey (MRFSS) data. Compared to the other two current sources of recreational data for California, these data provide the most comprehensive coverage for all recreational fishing types (modes) and species. However, constituents and fishery managers have expressed much concern over the use of these data in making crucial management decisions, particularly in-season decisions for groundfish. Observing a growing lack of credibility in the MRFSS program on the West Coast, policy representatives from the West Coast recommended the development of a new program. In response, staff from the California Department of Fish and Game (the Department) and the Pacific States Marine Fisheries Commission designed a new program for sampling California's recreational fisheries, incorporating both the comprehensive coverage of the MRFSS program and the high frequency on-site sampling (for the private vessel mode) of the Ocean Salmon Project.

A description of this program, the California Recreational Fisheries Survey (CRFS), is provided in this document. For 2003-2004, this program specifically includes the following:

- ⊘ Integration of California's current marine recreational sampling programs into one program;
- ⊘ Reporting of catch and effort at a finer geographical resolution;
- ⊘ Estimation of private/rental (PR) boat effort using an on-site approach;
- ⊘ Estimation of beach/bank and private access angler effort using an angler license database with the frame built from one out of every 20 licenses;
- ⊘ Continuation of the Commercial Passenger Fishing Vessel (CPFV) phone survey with effort;
- ⊘ Comparison of CPFV phone surveys with effort data collected directly from the landings and CPFV logbooks;

- € Increased creel sampling for PR and CPFV vessels;
- € Estimation of effort and catch on man-made structures using roving angler count surveys, and creel surveys;
- € Reporting of effort and catch estimates for all modes at monthly intervals; and
- € Sufficient sampling of PR boats to meet ocean salmon management data requirements, including the collection of coded wire tags.

The primary goal of the program will be to produce in a timely manner marine recreational, fishery-based data needed to sustainably manage California's marine recreational fishery resources. The changes proposed in this plan should increase the timeliness and accuracy of recreational fisheries data so that they can be more effectively used for in-season monitoring, estimating take for species of concern, developing harvest guidelines, producing stock assessments, and providing other information critical to management decisions. The initial focus of the program will be to produce timely catch estimates with reasonable confidence limits for those groundfish stocks declared overfished by National Marine Fisheries Service and for those stocks with a directed harvest. The Department will fully implement the CRFS 2003-2004 plan beginning in January 2004.

## Introduction

Over the past several years, recreational anglers, Commercial Passenger Fishing Vessel (CPFV) owners and operators, fishery managers, and other interested parties have discussed the Marine Life Management Act and its requirement that the State of California manage its marine resources on the basis of the best available scientific information as well as other relevant information (FGC §7050(b)(6)). Currently, the best available statewide recreational fishery-dependent data used for making management decisions for California's marine recreational fisheries come from three sources: 1) the Marine Recreational Fisheries Statistics Survey (MRFSS); 2) the California Department of Fish and Game's (the Department) Ocean Salmon Project (OSP); and 3) CPFV logbooks. Other important data sources, including the Northern/Central California CPFV Observation Program and the Northern California Launch Ramp Survey, have provided valuable data for making management decisions in the past; however, these programs are not currently active and each was focused on a specific area and fishery within California.

A major concern identified by constituents and fishery managers was the use of the MRFSS data in making crucial management decisions for groundfish, especially those related to in-season closures. This concern was specifically addressed in a letter by policy representatives from the Pacific Fisheries Management Council (the Council, PFMC), the Pacific States Marine Fisheries Commission (PSMFC), and three West Coast states in a letter (submitted November 15, 2002) to Dr. William Hogarth, Assistant Administrator for Fisheries at the National Marine Fisheries Service (NMFS) (Attachment A). This letter states that there is a lack of credibility in the MRFSS program on the West Coast and, in particular, "no confidence in the estimates of groundfish recreational catch being produced under the MRFSS methodology."

This letter included a recommendation that a new West Coast Recreational Data Program (WCRDP) be designed to meet the highest priority state and federal needs and suggested that this program include:

- ∓ Integration and expansion of state sampling programs to produce better estimates for groundfish and acceptable estimates for other state priority species;
- ∓ A set of designs for estimating effort that relies on methods with good precision, public acceptance and cost effectiveness.
- ∓ Catch estimates generated within a month after harvest to support in-season management; and

- ∄ Production of catch estimates with reasonable confidence limits for managing fish stocks that are federally designated as overfished.

The California Recreational Fisheries Survey (CRFS) program described in this document was developed, in part, as a response to the above concern and to meet the WCRDP recommendation. In framing this program, Department and PSMFC staff drew upon their knowledge of the three current recreational programs, retaining the strong points of the programs while minimizing potential shortcomings (described below under section on current programs). Through this process, staff designed a closely-knit, coordinated program that includes both the comprehensiveness of the MRFSS program and the high frequency on-site sampling (for the private vessel mode) of the OSP. For 2003-2004, this program specifically includes the following program elements:

- ∄ Integration of California's current marine recreational sampling programs into one program
- ∄ Reporting of catch and effort at a finer geographical resolution
- ∄ Estimation of private/rental (PR) boat effort using on-site approaches
- ∄ Estimation of beach/bank (BB), private access and night angler effort using an angler license database (ALD) with the frame built from one out of every 20 recreational fishing licenses
- ∄ Continuation of the CPFV vessel phone survey with effort
- ∄ Comparison of CPFV phone survey with effort data collected directly from the landings and CPFV logbooks
- ∄ Increased creel sampling for PR and CPFV vessels
- ∄ Estimation of effort and catch on man-made structures using roving angler count surveys, and creel surveys;
- ∄ Reporting of effort and catch estimates for all modes at monthly intervals
- ∄ Sufficient sampling of PR boats to meet ocean salmon management data requirements, including the collection of coded wire tags (CWTs)

The changes proposed in this plan should increase the timeliness and accuracy of recreational fisheries data so that they can be more effectively used for in-season monitoring, estimating take for species of concern, developing harvest guidelines, producing stock assessments, and providing other information critical to management decisions. The proposed budget is much larger than in the past (by about \$959,000 for California) in response to the need for more comprehensive and timely marine recreational fishery data.

### ***Description of Current Recreational Programs in California***

Descriptions of the MRFSS program, the OSP, and the CPFV Logbooks are presented below along with a brief description of each program's major strengths

and shortcomings. This information was used by Department and PSMFC staff in their development of the new CRFS program.

## **MRFSS**

MRFSS is a federally funded survey that has been conducted since mid-1979 with a hiatus from 1990 through 1992. MRFSS consists of an angler field survey (for estimating catch rates) paired with a randomized telephone survey (for estimating total effort). This nationwide program was designed to provide information on catch and effort trends over time (between years) on a broad geographic basis (e.g., Northern and Southern California). This program is comprehensive; it provides over 20 years of fishery-dependent information on most recreational species and covers all four major modes of recreational fishing along the entire coast of California. However, the level of sampling has not been adequate for in-season projections of catch in the wanted geographic areas.

Insufficient sample size and the inefficiency of the household telephone survey had a direct impact on the precision of the MRFSS data and its usefulness for managing California fisheries.

In particular, imprecision, inefficiency and timeliness issues have limited the ability of MRFSS data to be used for making in-season management decisions in the following ways:

- ∄ Effort and catch estimates are only generated every 2 months (wave) while in-season estimates of catch for quota management are needed on at least a monthly basis;
- ∄ Estimates may take 4-8 weeks to produce after the end of a given wave;
- ∄ Total effort and catch are estimated for only two regions, Southern and Northern California (boundary line at Pt. Conception), while fishery management is needed for smaller geographic units;
- ∄ Effort estimates have low precision for some modes when few angler households are sampled for a given wave-area-mode combination;
- ∄ Effort estimates are impacted by 2-month recall of anglers surveyed via phone;
- ∄ Accurate estimates of total take for species of concern are difficult to generate because of the small number of catch samples from the creel program; and
- ∄ Some fisheries have special monitoring needs which overwhelm and sometimes preclude sampling of other trip types.

## **Ocean Salmon Project**

Since 1962, the OSP has maintained a comprehensive ocean salmon recreational fishery monitoring program (see Attachment B for a complete description). The program is responsible for providing the information necessary to sustainably manage California's ocean recreational salmon fishery and to meet the biological and recovery goals for salmon populations. Each season, OSP samples at least 20% of all recreational PR and CPFV salmon landings to

produce the biweekly catch, effort and CWT contribution data needed by the PFMC and the California Fish and Game Commission for ocean and inland salmon fishery management. The OSP uses on site surveys to estimate effort and catch, a methodology that receives a high degree of acceptance in both the scientific and fishery communities. However, the sampling program focuses primarily on catch from major salmon ports (n=22); and is relatively expensive to implement.

### **CPFV Logbooks**

Since 1936, CPFV operators have been required to submit records (logbooks) to the Department for each fishing trip. For each logbook entry, the vessel operator must provide information on effort (number of anglers and number of hours fished) and take (type and number of fish caught). These logbooks are required for all gears and must be submitted monthly whether or not fish and/or invertebrates were retained. CPFV logbook data with effort and catch information by trip have been stored in Department databases since 1980. The CPFV logbook database's strength lies in its provision of information (that is required) for all fish taken aboard CPFVs for the entire state by port and Fish and Game block; thus it can be summarized at multiple geographic scales. It also contains the longest history of landings for recreational fish species. Its shortcomings fall into three major areas: 1) catch not always reported at the species level; 2) reporting accuracy of catch, effort, and fishing location varies among CPFV operators; and 3) logbook compliance has averaged less than 70% in recent years and varies among ports and between years.

### ***Power and Authority to Collect Recreational Information in California***

The Department must collect sport fish catch information to meet the conservation and management policies for California's marine living resources. The authority to collect this information is specified in the California Fish and Game Code (FGC) and California Code of Regulations (CCR), Title 14. (Specific FGC and CCR references are provided in Attachment C).

### **Goal and Objectives of CRFS Program**

Goal: To produce in a timely manner, marine recreational, fishery-based data needed to sustainably manage California's marine recreational fishery resources

Objective 1: Survey California's marine recreational fisheries using the following standards and criteria:

- Sampling period – monthly
- Reporting time unit – preliminary estimates within three weeks of the end of the sampling period
- Geographic unit – county lines, as described below

- Fishing area - within all marine waters (differentiating between inside and outside 3 miles and inside bays)
- Modes - all modes (PR, CPFV, BB, MM)
- Species – creel information collected on all finfish species
- Data elements include, but are not limited to:
  - Date and time of sample
  - Port / landing
  - Fishing location – point (latitude/longitude); if this is not available, by one nautical mile blocks
  - Bottom depth
  - Fishing method/gear (including spear)
  - Number of anglers
  - Type and number of fish kept and discarded
  - Fish size
  - For CPFVs only, marine mammal interaction information - presence/absence at minimum; more specific information (e.g. number of interactions) if possible
- Precision – for catch estimates, strive for proportional standard errors that are  $\pm 0.20$  (20%).

Objective 2: Continue minimum 20% sampling of PRs and CPFVs targeting salmon at primary sites during the salmon season to collect CWTs. Produce the biweekly catch-effort estimates by species, fishery, and PFMC major port area needed to meet the biological and recovery goals for West Coast salmon populations.

## **Description of CRFS Sampling Methodology**

Effort and catch information will be collected for the four major recreational fishery modes in California: 1) private and rental boats (PR); 2) Commercial Passenger Fishing Vessels (CPFVs); 3) man-made structures (MM); and 4) beaches and banks (BB).

### ***Methods Applicable to All Modes***

The sampling methodology for all modes will include the following:

1. California will be divided into six survey areas using county lines with two exceptions as described below:
  - a. Crescent City/Eureka Survey Area - Del Norte and Humboldt counties with the exception of Shelter Cove which will be included in the Fort Bragg area;
  - b. Fort Bragg Survey Area - Mendocino and Sonoma counties; includes Shelter Cove (see above) and Bodega Bay during closed salmon months;

- c. San Francisco Survey Area - San Francisco Bay and San Pablo Bay counties plus Marin County south through San Mateo County on the coast; includes Bodega Bay during open salmon months;
  - d. Monterey/Morro Bay Survey Area - Santa Cruz County south through San Luis Obispo County;
  - e. Santa Barbara Survey Area – Santa Barbara and Ventura counties; and
  - f. Southern Survey Area – Los Angeles County south through San Diego County.
2. Estimates of catch and effort will be made monthly for each survey area for non-salmon species and biweekly by PFMC major port area for salmon. Estimates will be made for each mode and will include estimates for private access and night fisheries. Each estimate of catch, effort, or catch rate (that is, CPUE: catch per unit effort) will be accompanied by an estimated variance for the estimate. Except as noted below for particular modes, calculation methods and equations used for estimates and estimated variances will largely follow those presented on pages 220-222 in Chapter 15 of K. H. Pollock, C. M. Jones, and T. L. Brown. 1994. Angler and Survey Methods and Their Applications in Fisheries Management. American Fisheries Society. 371 pp. Two other sources often invoked below are: Cochran. 1963. Sampling Techniques, Second Edition. Wiley Pub. 413 pp.; and Cochran. 1977. Sampling Techniques, Third Edition. Wiley Pub. 428pp. For brevity, these sources are henceforth cited as Pollock et al. 1994, Cochran 1963 and Cochran 1977.
  3. A California angler license database (ALD) will be created and a telephone survey conducted to estimate effort for all modes. These effort estimates will include both public and private access and day and night fishing. They will be used for either production estimates or for comparison to the CRFS production on-site effort estimates (for more details, see Private Access and Night PR Survey section).

### ***Private Rental Boat Fishing Mode***

Private and Rental boat fishing mode (PR) will be covered using three surveys with differing sample designs. The survey method is based on three types of access points. Access points are launch ramps, marinas and docks where these boats return from fishing in marine waters. The three types of access points are;

1. Primary PR: public sites with 90%+ catch of important species
2. Secondary PR: public sites with <10% of the catch of important species
3. Private PR: private access sites and night fishing with unknown catch.

Initially, primary and secondary sites will be determined by summarizing total catch of important species by site and month from existing programs (Attachment D). Additional data gathered in the new program and knowledge of future regulation changes will be used to determine primary or secondary site status



each month. A list of current private access PR sites will be maintained with each site defined in terms of its location and boundaries.

Primary sites will be surveyed with an access point survey for effort and catch. Secondary sites will be surveyed with a roving access point survey for effort and catch. Private access sites and night fishing will be surveyed with an angler license telephone survey for effort and trip type. Private access and night fishing catch will be based on catch by trip type in the primary and secondary surveys for catch.

The telephone survey for effort by trip type and site can be used for comparison with the on-site surveys for effort. The telephone survey can also be used to estimate fishing effort beginning and ending at night which is not covered at the primary and secondary PR sites. It will be assumed that catch rates by trip type at night and at private access sites will be the same as during the day at public access sites.

## **Primary PR Survey**

The primary PR survey is a public launch ramp access point survey for effort and catch at high use sites (primary sites) during daylight hours.

### **Effort**

Effort in the primary PR survey is sampled by counting boats returning from fishing and trailers remaining on site at the end of the day. Angler effort is sampled by counting anglers per fishing boat.

### ***Sample selection (frame, design, sample sizes)***

Primary sites will be stratified into survey areas for selection of days. A fixed number of days will be sampled at each site per month for effort (eight days is proposed based on modeling, Attachment D). Weekend days and weekdays will be allocated based on the distribution of effort between the day types for each site and month from existing surveys. Holidays will be treated as weekend days. Particular days will be chosen at random for each site without replacement. Selection without replacement will be extended to sites that are adjacent to reduce sampler travel costs. No site will be sampled more often than two week days and 1 weekend/holiday per week. This is to ensure that sampling at the primary site is spread out over the entire sample period.

### ***Data collection (method, elements)***

Samplers will be issued sampling assignments for a month and site in advance. Changes to these assignments will be discouraged. Samplers will arrive at a pre-determined site at a pre-determined time and remain on site for a set time [when there are no trailers](#). At least one sampler will be present at the site during the majority of daylight hours [or until all trailers are sampled](#).

Samplers will tally every boat that exits the water at the site, taking information on whether each boat contained anglers and if so, recording the number of

anglers and the type of trip (what species groups (s) they targeted). At primary sites with nearby private assess points (e.g. marinas), samplers also will separately count the number of boats that were missed (that is, the number of boats that proceeded past the primary site toward a nearby private assess point). At the end of the sampling day, samplers will tally the number of trailers remaining at the site.

Additional data that will be collected include the assignment number, arrival and departure time, site location, and date.

#### ***Data processing (data flow, validation)***

Samplers will insure accurate data recording by performing self-checks on the data during slack time and at the end of the work day. Weekly, Supervisors will organize and final check the daily forms for shipment and weekly catch summary for fax delivery to the Ocean Salmon Project (OSP) in Santa Rosa, CA. The Northern California Supervisor will ship the original forms to the Ocean Salmon Project (OSP) in Santa Rosa, CA each week. Weekly catch data for salmon are summarized on one form for faxing and rapid processing at OSP. The Southern California Supervisor will ship the original forms to their supervisor who will check the forms before shipping them on to PSMFC (or OSP when applicable).

OSP will perform checks on all forms received each week and provide feedback to sampler supervisors on quality. Supervisors will provide feedback to samplers and perform validation checks on samplers in the field to verify boat counts and samplers on-schedule presence at sites

PSMFC and OSP will perform checks on all forms received each week during key entry on computers. PSMFC and OSP will provide immediate feedback to supervisors who will inform samplers regarding data quality. OSP will transmit all data to PSMFC who will make all of the data and estimates available on the RecFIN web site for review.

#### ***Estimation and analysis (equations, comparisons)***

Estimates of total effort for the primary sites will be calculated using the total number of boats sampled during the time period, including missed boats, for each type of day (weekend/weekday), month, survey area, and trip type. If too few samples for a specific trip type are collected (for a given day type-month-survey area), then these samples will be combined with a similar trip type (e.g. halibut trips will be combined with rockfish trips). Estimation of effort (as in Pollock et al. 1994) is calculated for each trip-type stratum by

$$\hat{E} = N \frac{\sum_{i=1}^n e_i}{n},$$

where  $N$  is the number of possible sample days,  $n$  is the number of actual sample days and  $e_i$  is the fishing effort (boat trips) on the  $i^{\text{th}}$  sample day. The variance is estimated by

$$\text{Var}(\hat{E}) = N^2 \frac{1}{n} \left( \frac{1}{n} \sum_{i=1}^n (e_i - \bar{e})^2 \right)$$

This equation is given by Equation 2.19 on page 25 of Cochran 1963 and by Equation 2.21 on page 26 of Cochran 1977. Total effort estimates from selected strata will be combined to produce summaries of estimated total catch for combined strata (e.g. monthly, annual, and regional estimates). Angler effort (angler days)  $\hat{A}$  will be estimated as the product of the estimated number of boats (boat trips)  $\hat{E}$  and of the estimated average number  $\hat{a}$  of angler days per boat by

$$\hat{A} = \hat{a} \Delta \hat{E}$$

and the variance of this estimated effort by,

$$\text{Var}(\hat{A}) = \hat{E}^2 \text{Var}(\hat{a}) + \hat{a}^2 \text{Var}(\hat{E}) + 2 \hat{a} \hat{E} \text{Cov}(\hat{a}, \hat{E})$$

[Note. This equation is a corrected version of equation 15.8 on page 222 of Pollock et al 1994. Our equation here gives an unbiased estimate of the variance of  $\hat{A}$ , whereas equation 15.8 replaces our  $-$  with  $+$ , thereby giving a positively biased estimate. Equation 15.8 was likely suggested by the fact that the analogous equation for the true (rather than estimated) variance  $\text{Var}(\hat{A})$  of  $\hat{A}$  does use  $+$ ; namely it reads:  $\text{Var}(\hat{A}) = E^2 \text{Var}(\hat{a}) + a^2 \text{Var}(\hat{E}) + \text{Var}(\hat{E}) \text{Var}(\hat{a})$ .]

## CPUE

### **Sample selection (frame, design, sample sizes)**

The sample selection for CPUE is the same as the sample selection for effort.

### **Data collection (method, elements)**

The sampling of the catch at primary sites is conducted in conjunction with the PR effort survey. Below are the data elements that will be collected from each sampled boat and an explanation of why these data are needed (b-bookkeeping, including estimation, s-stock assessment, r-regulatory, and e-economic). Items denoted by \* are required for a valid sample.

1. Date\*—b and r
2. Time of interview—b
3. Sample number\*—b
4. Number of anglers\*—b, s, and r
5. Number of anglers with a license\*—b
6. California county of one angler per vessel—e (to be discontinued 7/1/04)

7. Days fished\*—b and s
8. Primary and secondary target of trip (type of trip)\*—b and s
9. Primary and secondary gear types—r
10. Number of fish landed by species\*—b, s, and r
11. Number of fish discarded alive or dead by species—b, s, and r
12. Fish lengths and weights of priority species
13. Fish length and the head removed from all ad-clipped salmon; a headtag must be attached to each head and its unique number recorded next to the sample\*—b, s, and r
14. Harvest location within 1 square nautical mile where most fish were caught, (determine if most fish were caught in state or federal waters)—s and r
15. Depth fished where most fish were caught (primarily nearshore and groundfish species) —s and r

Boats will be sampled for the pertinent data elements as listed above. Other data elements will be collected as time permits. During extremely busy times, the sampler may shift to a sampling scheme where pertinent data elements are collected from most boats while general information (e.g., number of anglers, trip type) is collected from a few boats.

Residence data will be collected in the form of the California county from one of the anglers in each boat (chosen at random). The county question will be asked to allow for calibration of the new CRFSS survey with the RDD survey. The angler license question will be used to determine what proportion of PR sampled anglers is represented within the ALD.

During the salmon season, an effort will be made to sample all PRs targeting salmon to collect catch-effort information and to examine the catch for ad-clipped salmon. Each ad-clipped salmon will be measured and its head removed. A uniquely numbered headtag must be attached to each head and its number recorded next to the sample.

An example of the test sample form for Bodega Bay is provided in Appendix 1.

***Data processing (data flow, validation)***

The CPUE data are collected and processed on the same form as the effort data.

***Estimation and Analysis (equations, comparisons)***

As with the estimation of total effort, estimates of CPUE will be calculated for each trip type and combination of other factors: day type (weekend or weekday), month and survey area. If too few samples for a given trip type and combination are collected, then those samples will be combined with those of a similar trip

type for the same combination of the other factors. For each trip-type stratum, catch rate (modified from Pollock et al 1994, page 221) is estimated by

$$\hat{R} = \frac{\sum_{i=1}^n c_i}{\sum_{i=1}^n m_i},$$

where  $c_i$  is the catch sampled on sampled boats,  $m_i$  is the number of boats sampled on the  $i^{\text{th}}$  sample day (missed boats are counted as un-sampled), and the summations are over all  $n$  sampled days. The estimated variance of this estimate is found as in Cochran 1964, 2.29 (and ensuing text on pages 30-31), or as in Cochran 1977, 2.39 (and ensuing text on pages 31-32). Namely, let  $\bar{m}$  be the mean of the values  $m_i$ . Then:

$$Var(\hat{R}) = \frac{1}{\bar{m}^2} \frac{(14 \frac{n}{N})}{n} \frac{\sum_{i=1}^n (c_i - \hat{R} m_i)^2}{n - 1}$$

Estimates of total catch will be calculated for each day type (weekend/weekday), month, survey area, and trip type (as in Pollock et al. 1964, 15.3, page 220) by

$$\hat{C} = \hat{E} \hat{R}$$

The variance (as in the corrected version of Pollock et al. 1994, 15.8, page 222) is estimated by

$$Var(\hat{C}) = \hat{E}^2 Var(\hat{R}) + \hat{R}^2 Var(\hat{E}) + 4 \hat{E} \hat{R} Cov(\hat{E}, \hat{R})$$

Total catch estimates from selected strata will be combined to produce summaries of estimated total catch for combined strata.

## Secondary PR Survey

The survey at secondary private and rental boat sites will be based on a roving access point survey for effort and catch. Secondary sites are defined as sites in a particular month that fall below the top 90% of sites by total catch of important species in the Northern or Southern California sub-regions.

### Effort

The secondary PR site roving survey will count boat trailers at access points for boat effort and sample complete trips for angler effort per boat. Samplers will rove among a cluster of sites in a geographic sub-area and perform systematically timed instantaneous counts of trailers.

***Sample selection (frame, design, sample sizes)***

After defining the list of secondary PR sites in a month, the sample frame will be stratified by sub-area and weekend-weekday type.

The number of sites in a sub-area will vary and will depend on the travel times among sites in each sub-region and the location of samplers work stations. The number of samples per month for each sub-area will be determined by examining the variance in the catch and effort estimated from the data in existing programs.

Sampling will be stratified by day type (weekend or weekday), month and sub-area (site cluster). Sites within sub-areas may be sampled with unequal probabilities in proportion to past effort values, as adjusted for expected regulatory changes. The distribution of weekend to weekday samples will be based on the distribution of effort in existing programs.

Selection of dates, initial sites, and start times within a sub-area will be done using random sampling, while weeks, day types and sub-areas will be selected using systematic sampling with a random sampling component, i.e., progressive sampling of a weighted and sorted list. This will insure that samples taken throughout the month will be temporally and geographically consistent and proportional to expected effort.

***Data collection (method, elements)***

Samplers will be issued sampling assignments for a month and sub-area in advance for scheduling. Changes to this schedule will be discouraged. Samplers will arrive at a pre-determined site at a pre-determined time and follow a pre-determined schedule of site visits. Samplers may rove among sites in a cluster once all of the sites have been visited and initial effort levels at each of the sub-sites have been determined.

Samplers will perform trailer counts at pre-determined times. Samplers will tally trailers by type by distinguishing between personal watercraft, sailboat and traditional boat trailers.

Data includes the assignment number, arrival and departure time, site location, date, start time of count, sampler id, trailer counts and comments recorded on paper forms.

***Data processing (data flow, validation)***

Samplers will insure accurate data recording by performing self-checks on the data during slack time and at the end of the work day. Samplers will organize and final check the forms for shipment or delivery to their supervisor weekly.

Supervisors will perform checks on all forms received each week and provide feedback to samplers on quality. Supervisor will also perform validation checks on samplers in the field to verify trailer counts and samplers on-schedule presence at sites. Supervisors will ship the forms to PSMFC each week.

PSMFC will perform checks on all forms received each week during key entry on computers. PSMFC will provide immediate feedback to supervisors and samplers

on data quality and make all of the data available on the RecFIN web site for review.

**Estimation and analysis (equations, comparisons)**

Effort estimation will begin by multiplying the average angler trailer count times the length of the fishing period in hours (daylight hours) (note Pollock et al. 1964, circa page 245) to generate estimates of trailer-hours per day. Effort  $a_i$  in angler days is the product of trailer hours per day and angler trips per trailer hour, for a fishing period  $i$ , and is estimated by

$$\hat{a}_i = (\bar{I}_i T) (\overline{P_b H_t B})_i,$$

where trailer hours per day  $(\bar{I}_i T)$  is the instantaneous count of boat trailers for fishing period,  $\bar{I}_i$ , multiplied by the length of the fishing period  $T_i$ . In the case that only one trailer count is made during the fishing period, this term has no variance and is assumed to be measured without error. In the case that several trailer counts are made during a fishing period, then  $(\bar{I}_i T)$  is estimated by

$$(\bar{I}_i T) = \frac{\sum_{l=1}^L (\bar{I}_{l,i} T_i)}{L}$$

where  $l=1, \dots, L$  trailer counts are made during fishing period  $i$ . In this case,  $(\bar{I}_i T)$  has the usual estimated variance

$$\text{Var}(\bar{I}_i T) = \frac{T_i^2 \sum_{l=1}^L \bar{I}_{l,i}^2 T_i}{l(l+1)}$$

Angler trips per trailer hour is the mean of  $(P_b H_t B)_{i,k}$ , the product of fishing boats per trailer ( $P_b$ ), trips per hour ( $H_t$ ) and anglers per boat ( $B$ ) where each of the three terms is observed for each boat interviewed ( $k=1 \dots K_i$  boats) in fishing period  $i$ . Note that  $H_t$  is the inverse of hours for boat trip  $k$ .  $P_b$  is the indicator ( $=0, 1$ ) of whether the boat interviewed is a fishing boat. For a non-fishing boat, this product will be zero (no angler hours) while for a fishing boat this product will measure the angler trips per trailer hour for fishing boat  $k$ .

The mean angler trips per trailer hour is

$$\overline{P_b H_t B}_i = \frac{\sum_{k=1}^{K_i} P_{b,i,k} H_{t,i,k} B_{i,k}}{K_i},$$

where  $K_i$  boats are interviewed in fishing period  $i$ . Its variance is

$$\hat{V}ar(\overline{P_b H_t B_i}) = \frac{\sum_{i=1}^K \Psi_{P_b H_t B_i}^2 / (K_i - 1)}{K_i (K_i - 1)}.$$

Total effort for a survey period in angler hours is estimated by

$$\hat{a} = \sum_{i=1}^n (\hat{a}_i / \phi_i)$$

Here  $\phi_i$  is the total probability (n/N) the period  $i$  is included in the sample.

Assuming that non-fishing pleasure boats are out for about the same duration as fishing boats on average, the estimate will be unbiased. If pleasure boats are out longer, then the effort estimates would be inflated. Studies aimed at measuring (and comparing) the trailer hours of fishing and non-fishing boats will measure this assumption.

The variance for angler effort is estimated by

$$\hat{V}ar(\hat{a}_i) = (\hat{I}_i T)^2 \hat{V}ar(\hat{P}_b \hat{H}_t \hat{B}_i) + 2 (\hat{P}_b \hat{H}_t \hat{B}_i)^2 \hat{V}ar(\hat{I}_i T) + 4 \hat{V}ar(\hat{I}_i T) \hat{V}ar(\hat{P}_b \hat{H}_t \hat{B}_i)$$

## CPUE

The secondary PR site roving survey will collect CPUE data by interviewing anglers from boats at the conclusion of their trips. Samplers will rove among a cluster of sites in a geographic sub-area and perform systematically timed instantaneous counts of trailers. Samplers will remain on-site for an amount of time in order to interview anglers at the conclusion of their trips before moving on to another site in the cluster.

### **Sample selection (frame, design, sample sizes)**

Because the CPUE data is collected between trailer counts for effort the sample selection is the same.

### **Data collection (method, elements)**

Samplers will interview any anglers who complete their trips while on-site and perform a creel census and ask about any unavailable fish. Data includes date and time, fishing time, location fished, type of trip, residence information, fishing license type, frequency of fishing, number of fish by species, and lengths and weights of available catch.

### **Data processing (data flow, validation)**

Samplers will provide edit checked data to their supervisors weekly. Supervisors will perform additional checks and provide feedback and mail the forms to PSMFC weekly. PSMFC will check and enter the data and make it available for review within a week of receiving it.

The data will be summarized monthly for estimation as soon as all data have been received and checked for quality. Estimates of catch and effort will be



available separately for analysis, but will be reported to the public as total catch and effort estimates for PR fishing by major port area.

**Estimation and Analysis (equations, comparisons)**

Catch rate will be calculated as the estimated catch divided by the estimated total number of anglers. Estimated catch will be calculated directly similar to the effort estimate. The per-day catch  $c_i$  of a given fishing period  $i$  is the product of trailer hours per day and catch per trailer hour, and is estimated by

$$\hat{c}_i | (\hat{I}_i T)(\overline{P_b C_i B}),$$

where trailer hours per day  $(\hat{I}_i T)$  is the instantaneous count of boat trailers,  $\hat{I}_i$ , multiplied by the length of the fishing period  $T$ . In the case that only one trailer count is made during the fishing period, this term has no variance and is assumed to be measured without error. In the case that several trailer counts are made during a fishing period, then  $(\bar{I}_i T)$  is estimated by

$$(\bar{I}_i T) | \frac{\sum_{l=1}^L (\bar{I}_{l,i} T_i)}{L}$$

where  $l=1, \dots, L$  trailer counts are made during fishing period  $i$ . In this case,  $(\bar{I}_i T)$  has the usual estimated variance

$$\hat{Var}(\bar{I}_i T_i) | \frac{T_i^2 \Psi_{I_{l,i} T} 4 \bar{I}_i T_i \beta}{l(l+1)}$$

Catch per trailer hour  $(P_b C_i B)$  is the product of fishing boats per trailer ( $P$ ), catch per angler hour ( $C_i$ ) and anglers per boat ( $B$ ). where each of the three terms is observed for each boat interviewed ( $k=1 \dots K_i$  boats) in fishing period  $i$ .  $P_b$  is the indicator ( $=0, 1$ ) of whether the boat interviewed is a fishing boat. For a non-fishing boat, this product will be zero (no angler catch) while for a fishing boat this product will measure the angler catch per trailer hour for fishing boat  $k$ .

The mean angler catch per trailer hour is

$$\overline{P_b C_i B}_i | \frac{\sum_{k=1}^{K_i} P_b C_i B_{i,k}}{K_i},$$

where  $K_i$  boats are interviewed in fishing period  $i$ . Its variance is

$$\hat{Var} \overline{P_b C_i B}_i | \frac{\sum_{k=1}^{K_i} \Psi_{P_b C_i B_{i,k}} 4 \overline{P_b C_i B}_i \beta}{K_i(K_i+1)}.$$

Total catch for a survey period in numbers of fish is estimated by

$$\hat{c} = \frac{n}{N} \sum_{i=1}^n (\hat{c}_i / \phi_i)$$

Here  $\phi_i$  is the total probability  $n/N$  the period  $i$  is included in the sample.

The variance for catch is estimated by

$$\hat{Var}(\hat{c}) = (\hat{I}_T)^2 \hat{Var}(\hat{P}_b \hat{C}_i \hat{B}) + 2 (\hat{P}_b \hat{C}_i \hat{B})^2 \hat{Var}(\hat{I}_T) + 4 \hat{Var}(\hat{I}_T) \hat{Var}(\hat{P}_b \hat{C}_i \hat{B})$$

Secondary PR effort estimates can be compared with effort estimates from the ALD for trips accessing the same sites during the daylight hours. This analysis will include a comparison of the number of angler trips by trip type.

### **Private Access and Night PR Estimates - Angler License Directory (ALD) Telephone Survey**

Private access sites and night fisheries have unknown catch rates because samplers are generally unable to access these boats at the end of their trips for interviews or unable to safely and efficiently survey fishing outside of daylight hours. The private access effort is diffuse with numerous access points which are often secured to protect private property. The means to make catch and effort estimates will be a combination of data from an angler license directory (ALD) telephone survey and information on catch rates by trip type from the two site access surveys.

#### **Effort**

Effort estimates will be based on the mean number of trips from a random sampling of ALD angler contacts adjusted for the 5% frame coverage and for the unlicensed anglers sampled during angler intercepts. Effort by unlicensed anglers via private access cannot further be accounted or adjusted for at this time.

#### ***Sample Selection (frame, design, sample sizes)***

Beginning in 2004, an angler information form will be printed on the cover of annual (both resident and nonresident) and short term (10-day nonresident, 2-day nonresident, and 1-day nonresident) sport fishing license booklets. Each booklet contains 20 licenses and the angler purchasing the first license will be asked to record their name and telephone number. The resulting sample frame will be a systematic 5% sample of all sport fishing license holders in California. Revisions will be available within ten days after the end of each month of sale.

Based on preseason projections of license sales, approximately 1.57 million licenses will be sold in California during 2004; thus an estimated 78,500 anglers will be in the ALD. Based on available funds, contact and response rates for a

similar survey in Washington, this program has proposed to complete 250-500 angler interviews per month or about 4-8% annually of the 5% frame sample.

Annual license holders may be contacted in any month in the calendar year after sale to determine fishing effort for the previous month. Daily license holders will be contacted only in the two months after sale because those licenses can be activated anytime after sale in the calendar year.

***Data Collection (method, elements)***

The 5% systematic sample will be sub-sampled by systematically sorting the frame geographically (area code) to insure uniform spatial distribution of the sample population. Observations falling within each geographic code will be randomized and the entire list stepped through in steps in proportion to the number of initial contacts wanted for dialing. The number of initial contacts will be adjusted upwards by 20-30% to account for no-contact rates seen in existing surveys of this type.

Anglers will be asked to provide information from all marine fishing trips, not just PR trips, made during the previous month in the telephone survey. For each trip anglers will be asked fishing mode, area of trip (ocean or inland), type of trip (target species), access type (public or private) and site of access (name of site), and starting and ending times (duration and time of day).

For PR trips, the trip type is necessary for determining which catch rates to apply from the public ramp boat intercepts. Trip types will be pre-defined. Trips not fitting into a pre-defined category will be categorized later based on the target species.

The site of PR boat access is needed to determine if the boat site is in the sampled public access list of sites or in the private access site list. Sites not in either list will be recorded and added to one of the lists based on the description provided over the telephone and an investigation of the site by a sampler, if necessary.

The number of trips which occur at night, with start and end times outside of daylight hours, needs to be determined for PR fishing mode. This number is needed so that estimates of this uncovered effort can be added to the primary and secondary fishing effort estimates from the access point effort surveys.

***Data Processing (data flow, validation)***

Adjustments for unlicensed anglers in each mode will be based on a combination of data sources. Anglers fishing from public piers are exempt from the license requirement; however anglers fishing in that mode will be asked about their license status so that data collected from the ALD survey will be useful in the analysis of man-made structure fishing mode. Anyone under age 16 is exempt from the license requirement; however, under-age 16 angler counts will be made during sampling. The state requires that all anglers display their license on or above the waistline so that it is plainly visible when engaged in the take of any fish (i.e., fishing). However, samplers will ask anglers not displaying their license

which type of license they have. These adjustments may be compared with enforcement statistics on the rate of unlicensed adult anglers cited by month, statistical area and fishing mode.

License and Revenue Branch in Sacramento will enter the anglers name and telephone number as part of their license tracking program. There is a unique bar code on each license book to assist tracking and quality control of the data. The frame data will be transmitted via secure electronic means for random-systematic selection of the dialing sample and the response data will be collected via computer assisted dialing (CAD) telephone surveying by a telephone survey contractor.

The response data will be merged back with the dialing sample and original frame by unique identifier and will be compared to validate the observations used in each month of dialing. No-contact and non-response rates will be tracked and reported. Complete response data will be available one month after dialing begins. Up to three weeks of dialing re-attempts will be allowed before a contact number is marked as a no-contact number.

#### ***Estimation and Analysis (equations, comparisons)***

Effort estimates will be calculated by expansion from the contacted sample of  $n$  anglers to the population of all  $N$  licensed anglers. An effort estimate will be made for each stratum of angler trips defined by trip type, access type (public or private) and day-night type (daytime or nighttime trip). An adjustment for unlicensed anglers from public access sites (anglers not in the telephone survey) will be made. It will be assumed that for each stratum angler trip rates are the same for unlicensed and licensed anglers.

Effort in any given angler-trip stratum will be estimated using this basic method:

$$\hat{E}_1 = \frac{N}{n} \sum_{i=1}^n t_i$$

Here, for each  $i$  among the  $n$  contacted anglers,  $t_i$  is the number of trips in the stratum made by angler  $i$ . Thus, the average number of per-angler stratum trips – the average taken for contacted licensed anglers - is multiplied by the total number  $N$  of licenses issued.

The variance of this effort estimate is estimated as

$$\hat{Var}(\hat{E}_1) = N^2 \frac{\sum_{i=1}^n (t_i - \bar{t})^2}{n(n-1)}$$

Here,  $\bar{t}$  is the mean of the sampled values  $t_i$ . Adjustment factors for trips not covered by the telephone survey are estimated from data collected by the boat intercept survey. In particular, the following adjustment is made for anglers not holding a fishing license. The proportion  $p = (\text{number licensed} / \text{total anglers})$  is estimated by  $\hat{p} = L/n$ , where  $n$  is the number of intercepted anglers and  $L$  is the number of those anglers with a license.

The initial effort estimate  $\hat{E}_1$  is adjusted to a corrected estimate  $\hat{E}_2$  by

$$\hat{E}_2 = \frac{1}{\hat{p}} \hat{E}_1,$$

The variance is estimated as the variance of a product, as was first done above for the Primary PR survey. Here, the factors of the product are simply  $1/\hat{p}$  and  $\hat{E}_1$ , and the variance of  $1/\hat{p}$  is estimated via the delta method as  $\frac{(14 \hat{p})}{n\hat{p}^3}$ ; so that

$$\text{Var}(\hat{E}_2) = \hat{E}_1^2 \frac{(14 \hat{p})}{n\hat{p}^3} + \frac{\text{Var}(\hat{E}_1)}{\hat{p}^2} + 4 \hat{E}_1 \frac{(14 \hat{p})}{n\hat{p}^3} \text{Cov}\left(\frac{1}{\hat{p}}, \hat{E}_1\right)$$

Effort estimates for the public access sites will be available for comparison with the effort estimates from the two on-site survey. Listing of individual access sites in the ALD survey output data will allow effort estimates to be made separately for the primary and secondary sites by major port area and month.

## CPUE

### ***Sample Selection (frame, design, sample sizes)***

As noted above, there is no direct sampling of the private access and night PR fisheries, so for these fisheries direct data are lacking not only for effort but also for CPUE and catch. All of the CPUE and effort data obtained from sampling in the two public access site surveys will be used to produce the CPUE estimates for private access sites and night fishing at the primary and secondary sites. Trip type will be stratified because it is assumed that trip type proportions may not be the same for public vs. private access, or for day vs. night trips. For example, it has been surmised that larger and more expensive moored boats participate in pelagic fisheries more frequently than public launch boats.

### ***Data Collection (method, elements)***

Catch rate by trip type will be summarized from the two public access PR surveys by major port area and month. For both surveys, collected data include the trip type.

### ***Data Processing (data flow, validation)***

Catch rate data will be summarized monthly and analyzed for completeness by major port area and trip type. Any trip types estimated in the effort portion which were not sampled in the CPUE section will have CPUE imputed from adjacent major port areas or months so that each trip type will have CPUE data to produce an estimate of total catch.

### Estimation and Analysis (equations, comparisons)

Catch and CPUE estimates will be stratified by month, major port area and trip type, exactly like effort estimates. The CPUE will be combined by the estimates of trips from the two catch surveys (primary and secondary) to properly represent the relative size of the primary and secondary site trip populations. The estimated mean catch per boat trip  $\hat{c}$  for each port area, month and trip type will be estimated as

$$\hat{c} = \frac{\hat{c}_p}{\hat{t}_p} + \frac{\hat{c}_s}{\hat{t}_s} = \frac{\hat{c}_p \hat{t}_s + \hat{c}_s \hat{t}_p}{\hat{t}_p \hat{t}_s} = \frac{\hat{c}_p \hat{t}_s + \hat{c}_s \hat{t}_p}{\hat{t}_p \hat{t}_s}$$

where  $\hat{c}_p$  | estimated mean catch per boat trip at “primary” sites

$\hat{c}_s$  | estimated mean catch per boat trip at “secondary” sites

$\hat{t}_p$  | estimated number of boat trips returning to “primary” sites

$\hat{t}_s$  | estimated number of boat trips returning to “secondary” sites

$\hat{c}$  | estimated total catch over all sites

$\hat{t}$  | estimated total number of boat trips over all sites

$\hat{c}_p$  | estimated total catch by boat trips returning to “primary” sites

$\hat{c}_s$  | estimated total catch by boat trips returning to “secondary” sites

The variance will be estimated as

$$\hat{V}(\hat{c}) = \frac{\hat{V}(\hat{c}_p)}{\hat{t}_p^2} + \frac{\hat{V}(\hat{c}_s)}{\hat{t}_s^2} + \frac{2\hat{COV}(\hat{c}_p, \hat{c}_s)}{\hat{t}_p \hat{t}_s}$$

where  $\hat{V}(\hat{c}_p) = \frac{\hat{c}_p^2}{\hat{t}_p} + \frac{\hat{c}_p^2}{\hat{t}_p^2}$

$$\hat{V}(\hat{c}_s) = \frac{\hat{c}_s^2}{\hat{t}_s} + \frac{\hat{c}_s^2}{\hat{t}_s^2}$$

$$\hat{V}(\hat{c}_p) = \frac{\hat{c}_p^2}{\hat{t}_p} + \frac{\hat{c}_p^2}{\hat{t}_p^2}$$

$$\hat{V}(\hat{c}_s) = \frac{\hat{c}_s^2}{\hat{t}_s} + \frac{\hat{c}_s^2}{\hat{t}_s^2}$$

$$\text{and } \hat{COV}(\hat{c}_p, \hat{c}_s) = \left( \frac{\hat{c}_p}{\hat{t}_p} - \frac{\hat{c}_s}{\hat{t}_s} \right) \left( \frac{\hat{c}_p}{\hat{t}_p} + \frac{\hat{c}_s}{\hat{t}_s} \right) = \frac{\hat{c}_p^2}{\hat{t}_p^2} - \frac{\hat{c}_s^2}{\hat{t}_s^2}$$

Total catch is then estimated by

$$\hat{C} = \hat{E}_2 \Delta \hat{c}$$

The variance of total catch is then estimated by

$$\hat{V}(\hat{C}) = \hat{E}_2^2 \hat{V}(\hat{c}) + \hat{c}^2 \hat{V}(\hat{E}_2) + 2 \hat{E}_2 \hat{c} \hat{COV}(\hat{E}_2, \hat{c})$$

The computation of mean CPUE above will also be used for both the private access and night fishing at secondary and primary PR sites where the two surveys are also combined.

Differences in effort by trip type for public and private access will be analyzed and considered for designing studies to compare catch rates between private and public access sites and measure bias.

### ***Commercial Passenger Fishing Vessel (CPFV) Mode***

There are four surveys of CPFV fishing currently operating which will be used in the CRFS without alteration. The existing programs are described here in some detail.

### **Ocean Salmon Project Survey for Catch and Effort**

The Department's Ocean Salmon Project (OSP) must observe at least 20% of the salmon landed by CPFVs for the collection of CWTs. Project staff will sample dockside CPFVs targeting salmon at primary port sites north of Pt Conception (Attachment B). According to CPFV logs, more than 96% of CPFV Chinook salmon landings during 2000 and 2001 were made at these primary sites (the retention of Coho salmon has been prohibited since 1995). Data collected includes number of anglers (includes CPFV skipper and crew if they fished for salmon), fishing method (troll or mooch), number of salmon landed by species, the number of ad-clipped (CWT) salmon by species, number of sub-legal Chinook and Coho released and number of salmon lost to pinniped interactions. Heads from all ad-clipped salmon sampled will be collected and transported to OSP's Santa Rosa laboratory for processing. These data will be used to create biweekly CPFV salmon catch and effort estimates by port area and the distribution of CWTs by time and area.

Estimation of catch for CPFVs targeting salmon will be based on direct dockside sampling (minimum 20% sampling level) of salmon CPFVs for catch and expanding these data based on total OSP daily boat counts by time and port. All salmon will be visually checked for the collection of CWTs. These data may be adjusted postseason using information from CPFV logbooks (see Attachment B).

### **Primary CPFV Survey**

The primary CPFV survey samples boats using an on-board observer survey for CPUE and a vessel telephone survey for effort which have been in place since the year 2000 (see Appendix 2).

#### **CPUE**

An on-board observer survey of passenger fishing boats operating out of CPFV ports will be used to collect angler and catch data. CPFVs with low numbers of anglers can be completely censused for angler catch. Small CPFVs that operate independently of a port and typically launch from public launch ramps or private marinas are excluded.

#### ***Sample selection (frame, design, sample sizes)***

Ports are selected based on past effort distributions and a vessel is selected at random for multiple vessel ports. Sampling occurs at the angler level, due to the

number of potential anglers and the inability of observers to monitor all of them for catch and discards during fishing. Sample selection for the CPFV catch survey sites will be based on historical distributions with possible adjustments for anticipated change. Selection of vessel trips within a CPFV port will be proportional to effort, trip types, and areas fished to represent the possible fisheries available at that port. CPFVs will be sampled at double the rate of that used in the past.

***Data collection (method, elements)***

Observers collect angler data from as many anglers as possible on the way out to the fishing grounds. During fishing, observers collect location, species counts, discard lengths and pinniped interaction data for as many anglers as can be observed. After conclusion of fishing, the anglers who were interviewed on the way out are surveyed for creel data including lengths of retained catch and retrieval of heads from ad-clipped salmon.

***Data processing (data flow, validation)***

Processing of CPUE data will be the same as the method described in the Private Access and Night PR Survey Section on page 21.

***Estimation and Analysis (equations, comparisons)***

Estimation of non-salmon catch for CPFVs will be based on the on-board on-site survey of catch for angler catch rates. CPUE will be estimated using the method described in the Private Access and Night PR Survey Section on page 22.

**Effort**

CPFV effort will be surveyed using a phone survey of CPFVs that operate in marine waters. The state requires that all vessels engaged in commercial activities have a current permit. These annual permits are updated yearly and will form the basis of the sample frame for the phone survey.

***Sample selection (frame, design, sample sizes)***

Ten percent of vessel operators are contacted weekly to report their trips. Information from this survey is then validated using information from roving surveys and other sources (see below). The methods of this survey are documented in Appendix G.

***Data collection (method, elements)***

The methods of this survey are documented in Appendix G.

***Data processing (data flow, validation)***

The methods of this survey are documented in Appendix G.



OSP boat counts of CPFVs targeting salmon north of Pt Conception at primary port areas (see Attachment B) may be used to validate and adjust the effort collected during the CPFV phone survey.

CPFV effort information taken from CPFV logbooks will be compared with the CPFV phone survey and OSP CPFV boat count data. Compliance in submitting these logbooks is quite variable throughout the state and so these logbook data are generally incomplete. Even so, they provide a useful source of CPFV effort information for comparing the phone and landings surveys.

#### ***Estimation and Analysis (equations, comparisons)***

Estimation of effort for CPFVs not targeting salmon will be based on the mean number of fishing trips of the 10% sample adjusted for unlisted vessels and differences in operational status seen in on-board CPFV creel and roving surveys.

The methods of this survey are documented in Appendix G.

### ***Beach and Bank (BB) Fishing Mode***

Two surveys will be used to get estimates for BB mode: a daylight survey of public access points for catch and a telephone survey for all effort. Catch data will be collected using a roving access point survey at publicly accessible beaches and banks during daylight hours. Effort will be estimated using an angler license (ALD) telephone survey. Effort will be stratified by trip type. Effort outside public daylight BB fishing is assumed to have the same catch rate as public daylight trips of the same type.

#### **Primary BB Survey**

The primary survey at beach and bank sites will be based on a roving access point survey for catch at public sites during daylight hours.

#### **CPUE**

The primary BB roving survey will interview anglers during or at the conclusion of their trips. No more than 50% of trips may be incomplete trips. Samplers will rove among a cluster of access points or continuous access in a geographic sub-area and intercept anglers. Samplers will be allowed to move on to another site in the cluster once sampling is unproductive at the current site.

The sampler will interview any trips that complete while on-site for angler catch rate. Samplers may also intercept some incomplete angler trips. These must be 50% or more complete to be eligible (i.e., eligible to be included in recorded input data). An incomplete trip's recorded catch will be based on catch and fishing time for the complete part of the trip and on the planned remaining fishing time. Additional catch for remaining fishing time is imputed by sub-area and trip type or higher strata if complete trips are missing in a stratum.

***Sample selection (frame, design, sample sizes)***

The sample includes all public sites open to the ocean or within saltwater bays and estuaries. All natural shoreline are included in the site list with sites defined as stretches of shoreline with range boundaries. Well defined landmarks demark freshwater cutoff points. Man-made shoreline is also included where it does not project into open water to form a structure with water on both sides (definition of MM fishing mode).

Site selection is based on the distribution of effort from existing surveys. Site selection probability is non-uniform and proportional to effort. Private property shoreline and night fishing is excluded. Site clusters are groups of sites within 1 hour of travel time or less of each other within geographic strata. Each cluster will be sampled at least once a month. Effective sample size will be about the same as the existing survey.

Anglers are interviewed for angler and creel data while fishing or at the conclusion of fishing. At least 50% of interviews must be from anglers who have completed angling for the day. Anglers who are still fishing must have fished 50% or more of the projected total fishing time. Incomplete trips are catch rate adjusted (imputed) based on projected remaining fishing time.

***Data collection (method, elements)***

Samplers will interview any anglers who complete their trips while on-site and perform a creel check and ask about any unavailable fish. A random selection of anglers who have not completed their trips may be sampled when anglers do not conclude their trips when the sampler is scheduled to leave.

Data includes site, date and time, fishing time, remaining fishing time for some incomplete trips, type of trip, residence information, fishing license type, frequency of fishing, number of fish by species, lengths and weights of available catch, and numbers of unavailable reported catch.

***Data processing (data flow, validation)***

Samplers will provide edit checked data to their supervisors weekly. Supervisors will perform additional checks and provide feedback and mail the forms to PSMFC weekly. PSMFC will check and enter the data and make it available for review within a week of receiving it. Supervisor will perform spot check to see if samplers are on-schedule on assigned site-days.

The data will be summarized monthly for estimation as soon as all data have been received and checked for quality. Estimates of catch and effort by sub-types (trip type, access type and day-night type) will be available separately for analysis, but will be reported to the public as total catch and effort estimates for all BB fishing by geographic area.

***Estimation and Analysis (equations, comparisons)***

Estimation of the catch rate for beaches is based on summarizing the sample from an access point survey. Catch rate  $\hat{c}_1$  will be calculated by summing the total

catch  $c_i$  divided by the sum of the number of anglers  $a_i$  sampled in time period and geographic area  $i$  by:

$$\hat{c}_1 = \frac{\sum_{i=1}^n c_i}{\sum_{i=1}^n a_i},$$

Some of the trips ( $n$ ) will be incomplete trips, which is adjusted by imputation of the added catch by computing an adjusted catch rate  $\hat{c}_2$  for each species, time period and geographic area  $i$  by

$$\hat{c}_2 = \frac{\sum_{i=1}^n \frac{h_i}{t_i} \frac{c_i}{h_i}}{\sum_{i=1}^n \frac{h_i}{t_i} \frac{c_i}{h_i} + \sum_{i=1}^n \frac{h_i}{t_i} \frac{c_i}{h_i} \frac{r_i}{h_i}}$$

Where  $h_i$  is the hours fished in time period and geographic area  $i$ ,  $r_i$  is added hours reported still to be fished  $t_i$  is the number of angler trips sampled, and  $c_i$  is number of fish caught. Note that when the added hours  $r_i$  are zero, the product of hours per trip  $h_i/t_i$  and catch per hour  $c_i/h_i$  is unadjusted catch per trip ( $\hat{c}_1$  or  $\hat{c}_2$ ). The variance for the adjusted catch  $\hat{c}_2$  when  $r_i$  is greater than zero is assumed to be the same as the variance of  $\hat{c}_1$ .

Catch estimates will be further stratified by trip type for analysis and estimation of the private access and night BB fisheries estimates.

Total catch is estimated by

$$\hat{C} = \hat{E}_2 \Delta \hat{c}_2,$$

where  $\hat{c}_2$  is the adjusted catch rate of anglers and  $\hat{E}_2$  is the adjusted effort estimate.

### Effort

The ALD will be used to estimate all BB effort. Effort will be stratified by month geographic area, trip type and day-night type. Effort by trip type and day-night type will be used to calculate catch estimates by trip type for the uncovered CPUE at private and night access fisheries.

### Sample selection (frame, design, sample sizes)

Sample selection for the ALD survey is described in the Private Access and Night PR Survey Section on page 18.

### Data collection (method, elements)

Data collection for the ALD survey is described in the Private Access and Night PR Survey Section on page 19.

Data elements will include trip start and ending times to identify BB trips at night and site of access to identify sites outside of the public shore sample frame.

***Data processing (data flow, validation)***

Data processing of the ALD survey is described in the Private Access and Night PR Survey Section on page 19.

***Estimation and analysis (equations, comparisons)***

Effort will be estimated using the method described in the Private Access and Night PR Estimation Section on page 20.

## ***Man Made Structure (MM) Fishing Mode***

Two surveys will be used to get estimates for MM mode: a roving survey of public access points for catch and effort and a telephone survey for effort. Catch and effort data will be collected using a roving clustered access point survey at publicly accessible MM structures during daylight hours. Effort will be also estimated using an angler license (ALD) telephone survey. The ALD survey will primarily be used to estimate night and private access effort. Effort will be stratified by trip type. Effort outside public daylight MM fishing is assumed to have the same catch rate as public daylight trips of the same type.

### **MM Survey**

The primary survey at man made structure sites will be based on a roving access point survey for effort and catch at public sites during daylight hours.

#### **CPUE**

The primary MM roving survey will count anglers at access points for effort and interview anglers during or at the conclusion of their trips. No more than 50% of recorded trips may be incomplete trips.

Samplers will rove among a cluster of sites in a geographic sub-area and intercept anglers. Samplers will remain on-site for a pre-determined amount of time before moving on to another site in the cluster. The sampler will interview any trips that complete while on-site for angler catch rate. Samplers may also intercept some angler trips which must be 50% or more complete to be eligible.

Effort estimation will be made by multiplying the average angler count times the length of the fishing period in hours (daylight hours). Catch rate will be calculated by summing the total catch divided by the sum of the trip lengths. Incomplete trips will be based on catch and fishing time for the complete part of the trip. Additional effort for remaining fishing time is accounted for in the effort calculations.

**Sample selection (frame, design, sample sizes)**

Because the CPUE data is collected between angler counts for effort, the sample selection is the same.

**Data collection (method, elements)**

Samplers will interview any anglers who complete their trips while on-site and perform a creel check and ask about any unavailable fish. Data includes [site](#), date and time, fishing time, remaining fishing time for some incomplete trips, type of trip, residence information, fishing license type, frequency of fishing, number of fish by species, lengths and weights of available catch, [and numbers of unavailable reported catch](#).

**Data processing (data flow, validation)**

Samplers will provide edit checked data to their supervisors weekly. Supervisors will perform additional checks and provide feedback and mail the forms to PSMFC weekly. PSMFC will check and enter the data and make it available for review within a week of receiving it.

The data will be summarized monthly for estimation as soon as all data have been received and checked for quality. Estimates of catch and effort by sub-types (trip type, access type and day-night type) will be available separately for analysis, but will be reported to the public as total catch and effort estimates for all MM fishing by geographic area.

**Estimation and Analysis (equations, comparisons)**

Catch rate will be calculated by the estimated catch divided by the estimated anglers. Estimated catch will be calculated directly similar to the effort estimate.

The catch estimate  $\hat{C}_i$  of a given fishing period  $i$  is the product of angler hours per day and catch per angler hour and is estimated by

$$\hat{C}_i | (\hat{I}_i T) \hat{C}_i,$$

where angler hours per day  $(\hat{I}_i T)$  is the instantaneous count of anglers,  $\hat{I}_i$ , multiplied by the length of the fishing period  $T$ , and  $\hat{C}_i$  is the catch per angler hour and will be calculated the same as for BB trips, page 26. Total catch for a survey period in numbers of fish is estimated by

$$\hat{C} | \frac{n}{i|1} (\hat{C}_i / \phi_i)$$

Here  $\phi_i$  is the total probability  $n/N$  that the period  $i$  is included in the sample.

The variance for catch is estimated by

$$\hat{Var}(\hat{C}_i) | (\hat{I}_i T)^2 \hat{Var}(\hat{C}_i) + 2 (\hat{C}_i)^2 \hat{Var}(\hat{I}_i T) + 4 \hat{Var}(\hat{I}_i T) \hat{Var}(\hat{C}_i)$$

MM effort estimates can be compared with effort estimates from the ALD survey for trips accessing the same sites during the daylight hours. This analysis will include a comparison of the number of angler trips by trip type. However, this comparison will be hampered by the fishing regulation that allows angling in this mode without a fishing license. Fewer reports of MM trips are expected to be found in the ALD survey because of this exception.

#### **Effort**

The MM site roving survey will count anglers at access points for effort. Samplers will rove among a cluster of sites in a geographic sub-area and perform systematically timed instantaneous counts of anglers.

#### ***Sample selection (frame, design, sample sizes)***

After defining the list of MM sites with effort in a month, the sample frame will be stratified by sub-area and weekend-weekday type.

The number of sites in a sub-area will vary dependant on the travel times among sites in each sub-region and the location of samplers work stations. The number of samples per month for each sub-area will be determined by examining the variance in the catch and effort estimated from the data in existing programs. It is expected to be 1-3 samples per cluster.

Sampling will be stratified by day type (weekend or weekday), month and sub-area (site cluster). Sites within sub-areas may be sampled with unequal probabilities in proportion to past effort values, as adjusted for expected regulatory changes. The distribution of weekend to weekday samples will be based on the distribution of effort in existing programs.

Selection of dates, initial sites, and start times within a sub-area will be systematic to insure that samples taken throughout the month is a representative sample of the time period.

#### ***Data collection (method, elements)***

Samplers will be issued sampling assignments for a month and sub-area in advance for scheduling. Changes to this schedule will be discouraged. Samplers will arrive at a pre-determined site at a pre-determined time and follow a pre-determined schedule of site visits. Samplers will remain on-site to sample anglers for a time before moving on to the next site in the cluster. Samplers may return to a previously sampled site in order to sample anglers who will be completing their trips later in the day.

Samplers will perform angler counts at pre-determined times. Samplers will tally anglers, distinguishing between anglers and non-anglers.

Data includes the assignment number, arrival and departure time, site location, date, start time of count, sampler identification, angler counts and comments recorded on paper forms.

#### ***Data processing (data flow, validation)***

Samplers will insure accurate data recording by performing self-checks on the data during slack time and at the end of the work day. Samplers will organize and final check the forms for shipment or delivery to their supervisor weekly.

Supervisors will perform checks on all forms received each week and provide feedback to samplers on quality. Supervisor will also perform validation checks on samplers in the field to verify angler counts and samplers on-schedule presence at sites. Supervisors will ship the forms to PSMFC each week.

PSMFC will perform checks on all forms received each week during key entry on computers. PSMFC will provide immediate feedback to supervisors and samplers on data quality and make all of the data available on the RecFIN web site for review.

### ***Estimation and analysis (equations, comparisons)***

Effort estimation for MM will begin by multiplying the average angler count times the length of the fishing period in hours (daylight hours) (note Pollock et al. 1964, circa page 245). Effort  $a_i$  in angler days is the product of angler hours per day and trips per hour, for a fishing period  $i$ , and is estimated by

$$\hat{a}_i | (\hat{I}_i T) \hat{H}_i.$$

Angler hours per day ( $\hat{I}_i T$ ) is the instantaneous count of anglers  $\hat{I}_i$ , multiplied by the length (in hours per day) of the fishing period  $T$ . Note that angler trips per hour ( $\hat{H}_i$ ) is the inverse of hours per trip (trip duration). Total effort for a survey period in angler hours is estimated by

$$\hat{a} | \frac{n}{i | 1} (\hat{a}_i / \phi_i)$$

Here  $\phi_i$  is the total probability  $n/N$  that the period  $i$  is included in the sample.

The variance for angler effort is estimated by

$$\hat{Var}(\hat{a}_i) | (\hat{I}_i T)^2 \hat{Var}(\hat{H}_i) + 2 \hat{H}_i^2 \hat{Var}(\hat{I}_i T) + 4 \hat{Var}(\hat{I}_i T) \hat{Var}(\hat{H}_i)$$

Catch estimates will be further stratified by trip type for analysis and estimation of the private access and night MM fisheries estimates. Some incomplete trips may be included in the data and adjusted for using the same methods as for BB mode of fishing, page 27.

### **Private Access and Night MM Estimates**

Angler fishing licenses are not required on MM structures; however, a proportion of anglers who possess licenses fish in MM mode. Data from the angler license telephone survey will be useful for making adjustments for missed effort. Missed effort estimates from this adjustment may be highly variable, depending on the proportion of anglers who are licensed in MM mode. Missed effort includes anglers fishing from private property and anglers fishing at night at public sites.

Private access sites have unknown catch rates because samplers are unable to access private property. The private access effort is diffuse with numerous access points which are often secured to protect private property. Night fisheries are accessible, but are a security issue for samplers who should work in teams when doing so. Due to cost constraints, an off-site method was chosen for night fisheries.

The means to make catch and effort estimates for uncovered effort in the roving survey will be a combination of effort data by trip type from the angler license directory (ALD) telephone survey and information on catch rates by trip type from the roving access survey.

## **CPUE**

### ***Sample Selection (frame, design, sample sizes)***

As noted, there is no direct sampling of the private access and night MM fisheries, so for these fisheries direct data are lacking not only for effort but also for CPUE and catch. All of the CPUE and effort data obtained from the roving public access site surveys will be used to produce the CPUE estimates for private access sites and night fishing at all sites. Trip type will be stratified because it is assumed that trip type proportions may not be the same for public vs. private access, or for day vs. night trips. For example, it has been determined that night anglers participate in squid-related fisheries more frequently than day anglers.

### ***Data Collection (method, elements)***

Catch rate by trip type will be summarized from the roving MM survey by geographic area and month.

### ***Data Processing (data flow, validation)***

Catch rate data will be summarized monthly and analyzed for completeness by geographic area and trip type. Any trip types estimated in the effort portion which were not sampled in the CPUE section will have CPUE imputed from adjacent geographic areas or months so that each trip type with effort will have CPUE data to produce an estimate of total catch. Validation of individual CPUE records will be conducted prior to extraction for private access and night data use.

### ***Estimation and Analysis (equations, comparisons)***

Catch and CPUE estimates will be stratified by month, geographic area and trip type, exactly as for effort estimates. Catch rate and total catch for MM is estimated using the same methods as used for BB estimates, page 26.

The same CPUE data will be used for both the private access and night fishing at MM sites.

It will be assumed that catch rates by trip type at night and at private access sites will be the same as during the day at public access sites. In order eventually to learn of possible bias arising from use of this assumption, studies will be



designed to analyze and compare differences in effort and in catch rates for public vs. private access and for day vs. night trips.

The telephone (ALD) survey for effort by trip type and site can be used for comparison with the on-site survey for effort.

## **Effort**

### ***Sample Selection (frame, design, sample sizes)***

Sample selection for the ALD survey is described in the Private Access and Night PR Survey Section on page 18.

### ***Data Collection (method, elements)***

Data collection for the ALD survey is described in the Private Access and Night PR Survey Section on page 18.

For MM trips each trip profiled on the telephone survey will include the trip type, site of access and day-night type. Catch data will not be collected over the telephone.

The trip type is necessary for determining which catch rates to apply from the angler intercepts. Trip types will be pre-defined. Trips not fitting into a pre-defined category will be categorized based on the target or catch species.

The site of angler fishing is needed to determine if the structure site is in the sampled public access list of sites or in the private access site list. Sites not in either list will be recorded and added to one of the lists based on the description provided over the telephone and an investigation of the site by a sampler.

The number of trips which occur at night, with start and end times outside of daylight hours, needs to be determined. This number is needed so that estimates of this effort can be added to the primary MM fishing effort.

### ***Data Processing (data flow, validation)***

Data Processing for the ALD survey is treated in the Private Access and Night PR Survey Section on page 19.

### ***Estimation and Analysis (equations, comparisons)***

Estimation and analysis for the ALD survey is treated in the Private Access and Night PR Survey Section on page 20.

## ***Random Digit Dialing Calibration***

The Random Digit Dialing (RDD) survey was used to contact households in counties adjacent to marine waters and in inland counties where a significant number of marine trips had historically been documented. Random dialing of the last few digits within blocks of residential household telephone numbers is used to determine the percentage of angler trips. Annual estimates, obtained from market tracking, of the total number of occupied residential households are then used to estimate the population of angler trips by fishing mode (type of shore or

boat) in the dialing counties. On-site surveys must collect data to determine the percentage of anglers not in the dialing counties as an adjustment factor. NOAA-NMFS has conducted the RDD survey since 1980 with some periodic hiatuses due to funding issues. Support for the RDD survey will be maintained long enough to form a baseline comparison for continuity of the MRFSS data collection with the new methods.

### ***Optimizing Sampling Procedures***

Where possible, efforts will be taken to optimize sampling procedures. Some of these efforts are described in Attachment E.

### ***Potential Biases***

Like any other monitoring program, the potential exists for bias problems in the CRFS program. As part of the process of developing this program, a review of potential sources of bias in the CRFS program was conducted by a Department statistician. This review, provided in Attachment F, will assist Department staff in their efforts to minimize the biases within the CRFS program.

### **Testing Potential Biases**

Potential biases exist for proposed new methods. There is an effort to account for various biases by performing studies to measure their impact. The nature of the biases can primarily be outlined by listing the assumptions used. Most of these assumptions are mentioned in their respective sections by mode and estimation of effort or catch. The common general assumptions are listed here.

#### **Assumptions for proposed site selection methods:**

- 1) Catch rates are sampled proportionally within secondary PR public access site clusters,
- 2) Effort and catch for sampled and un-sampled days are similarly distributed.
- 3) Un-sampled catches in private vs. public access sites are similarly distributed for each combination of mode and trip type.
- 4) For each given trip type, catches during un-sampled and sampled time of day (day and night fisheries) are similarly distributed.
- 5) Site catch and effort estimates for 1999-2002 are representative of initial distribution.
- 6) Single-day trip catch is representative of days within multiple-day trips.

#### **Assumptions for proposed sampling of catch:**

- 1) Catch rates and effort hours are similarly distributed for sampled and un-sampled anglers at sampled sites,
- 2) Catch rates of incomplete trips can be adjusted based on the catch up to the time of the interview.

**Assumptions for proposed sampling of effort:**

- 1) The rate of unlicensed anglers is the same for sampled and un-sampled angler trips.
- 2) Trip durations in hours are similarly distributed for sampled and un-sampled anglers at sampled sites.
- 3) Instantaneous counts are similarly distributed for sampled and un-sampled days
- 6) Unlicensed anglers will report that fact to samplers when asked about type of license used.

**Assumptions for proposed methods of estimation:**

- 1) The rate of unlicensed anglers is the same for public and private access angler trips.
- 2) Catch rates for private boats and each given trip type are similarly distributed for private and public access.
- 3) Anglers under the age of 16 don't have fishing licenses.
- 4) The proportion of unlicensed anglers at sampled sites is representative of all sites.
- 5) Instantaneous counts are proportional to total effort.
- 6) The rate of private access site usage by license holders will be representative of all anglers, licensed and not.

**Assumptions for proposed optimized sampling procedures:**

- 1) Sampled catch within clusters of sites is representative of the aggregate.
- 2) Sampling of sites proportional to effort is representative of the aggregate.
- 3) Unlimited sampling of anglers at all sites is representative of the aggregate.
- 4) Sampling of boat catch is representative of individual angler catch.
- 5) Sub-sampling of data during high activity periods is representative of the day.

## **Budget Analysis and Projected Expenditures**

### ***Modeling Staffing Costs***

Optimized distribution of sampling for catch of management species and by total effort results in highly seasonal distribution of staff sampling effort, especially in the north where weather becomes a dominant factor. California sampling effort in all modes ranges from 200 sample days in January to 500 in August while north of Pt. Conception the sampling effort ranges from 100 sample days to 300 sample days in the same months. North of San Francisco, the distribution becomes even more extreme, ranging from 2 to 85 sample days per month. Strong seasonal distributions of sampling effort require wide ranging numbers of

seasonal and/or part time samplers which may cause data collection problems, if staff are not acquired or retained at the appropriate times, or budget problems if staff are not dismissed when no longer needed. Recruitment, retention and training of part-time seasonal samplers will be a significant issue for supervisors, especially in the northern part of the state.

A spreadsheet model is currently being developed to estimate our sampling costs by survey area and fishery mode. In this model, staffing costs are optimized independent of the number of samplers needed and their distribution. However, given the need to consider recruitment and retention issues as discussed above and the need to stay within budget, this model will have to be adjusted to allow for some flexibility.

### ***Timeline***

Currently, the implementation timeline for the CRFS program is as follows:

1. July 2003 – October 2003
  - a. Iron out methodology details for CRFS program
2. September 2003 – December 2003
  - a. Increase CPFV and PR sampling throughout state
  - b. Refine sampling protocol for private/rental public access boats
  - c. Refine sampling protocol for man-made structures
  - d. Compare species composition of catch from private and public access boats and day and night fisheries from shore.
  - e. Test proposed methods and procedures
3. January 2004
  - a. Implement new effort and catch sampling methodologies for private/rental and shore modes

### **Future Changes to the CRFS Program**

The CRFS program, as described above, will provide information critical for in-season management of California's finfish fisheries. However, the Department plans to continue improving the program where needed including the following:

The Department will continue its efforts to produce a saltwater angler license database system, expanding from the one built using the angler information collected from one out of every 20 licenses to a database system with angler information from all saltwater fishing licenses.

Department staff will continue their efforts to develop a better methodology for surveying private access catch. Staff will use the results of a pilot study comparing catch from launch ramp and private access (marina) vessels to determine 1) how similar catch (number and species composition) by target species group are for private access and launch ramp boats; and 2) if using a

creel survey methodology for private access vessels is financially feasible. Alternative methods also will be explored including logbooks from anglers contacted through the ALD phone survey.

Given additional funding, Department staff will identify sites where invertebrates are taken by recreational fishermen and begin developing the appropriate methodologies needed to include these in the CRFS program.

Department staff will explore the possibility of increasing roving effort surveys using senior volunteers. Through a senior volunteer program developed by Department staff, over 50 senior volunteers have been trained and are now assisting Department staff with enforcement, hunter education, and office support activities (for more information, see [www.dfg.ca.gov/enforcement/volunteers/](http://www.dfg.ca.gov/enforcement/volunteers/)).

## **List of Attachments and Appendices**

***Attachment A – November 15, 2002 Letter to Dr. William Hogarth***

***Attachment B – Ocean Salmon Project document***

***Attachment C – CDFG Authority to Collect Recreational Data***

***Attachment D – Site Stratification for PR Public Access Boats***

***Attachment E - Optimizing Sampling Procedures***

***Attachment F – Potential Biases in Angler Surveys (from Calvin C)***

***Appendix 1A and 1B – CRFS Draft Sampling Form for Private and Rental Boats***

***Appendix 2 – Statistical Methods for Primary CPFV Survey***